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EVIDENCE OF EVOLUTION

**What evidence do we have
that life has evolved
gradually from simple life
forms to complex life forms
over millions of years?**

Evidence that Evolution

1. Fossils
2. Homologous and Analogous structures
3. Vestigial Structures
4. Embryonic Development
5. Biogeography
6. DNA (Biochemical similarities)



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Fossil Evidence



What is a fossil?

- The preserved or mineralized remains (bone, tooth, or shell) or traces (footprints, burrow, or imprint) of an organism that lived long ago.



Ammonite fossil (shell)



Dinosaur fossil - (bone)

Fossils are very old



Trilobite fossils
445 million years ago



Stingray fossil
95 million year old



Beetle fossil
50 million years old



Bird egg fossil
1 million years old

How do fossils form?

- Most fossils are laid down in sedimentary rock - (particles carried by streams and rivers that eventually settle to the bottom in layers)
- The deeper down you go, the simpler the life forms are.
 - *life began as simple cells and gradually became more complex because...*



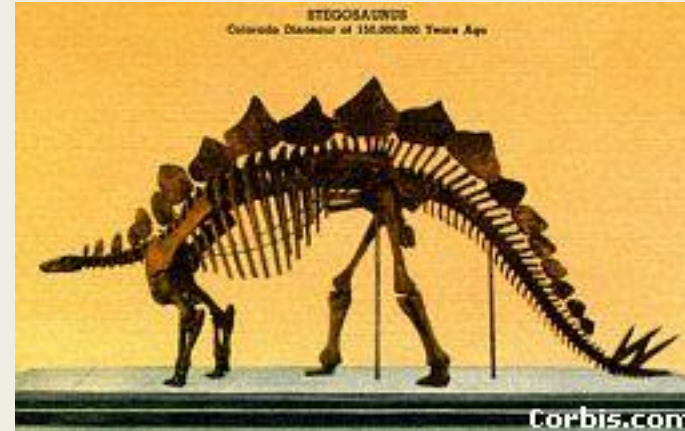


Older, simpler fossils at the bottom

The fossil record shows that some organisms that once lived are now extinct



triceratops



stegosaurus

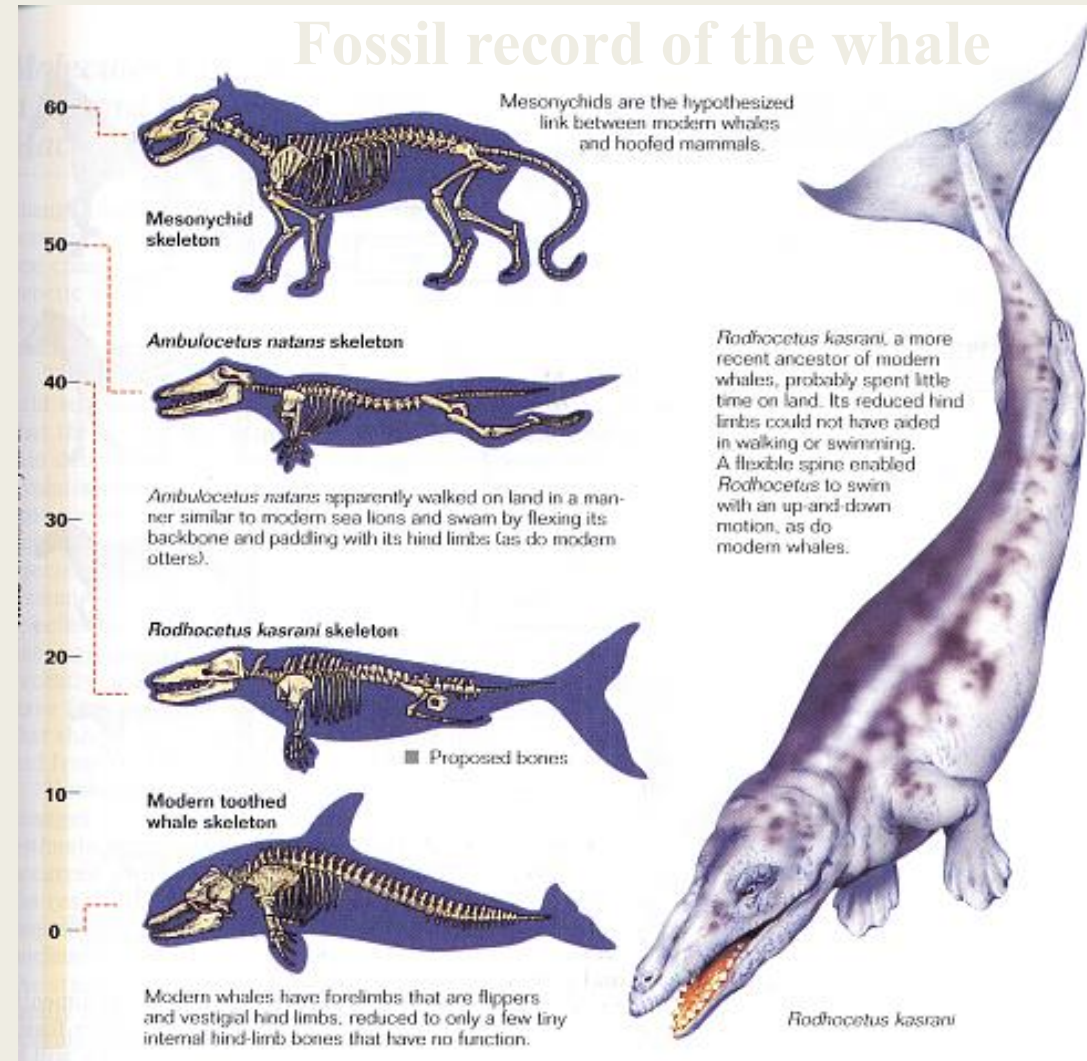


archeopteros

The fossil record can show that organisms changed gradually over time

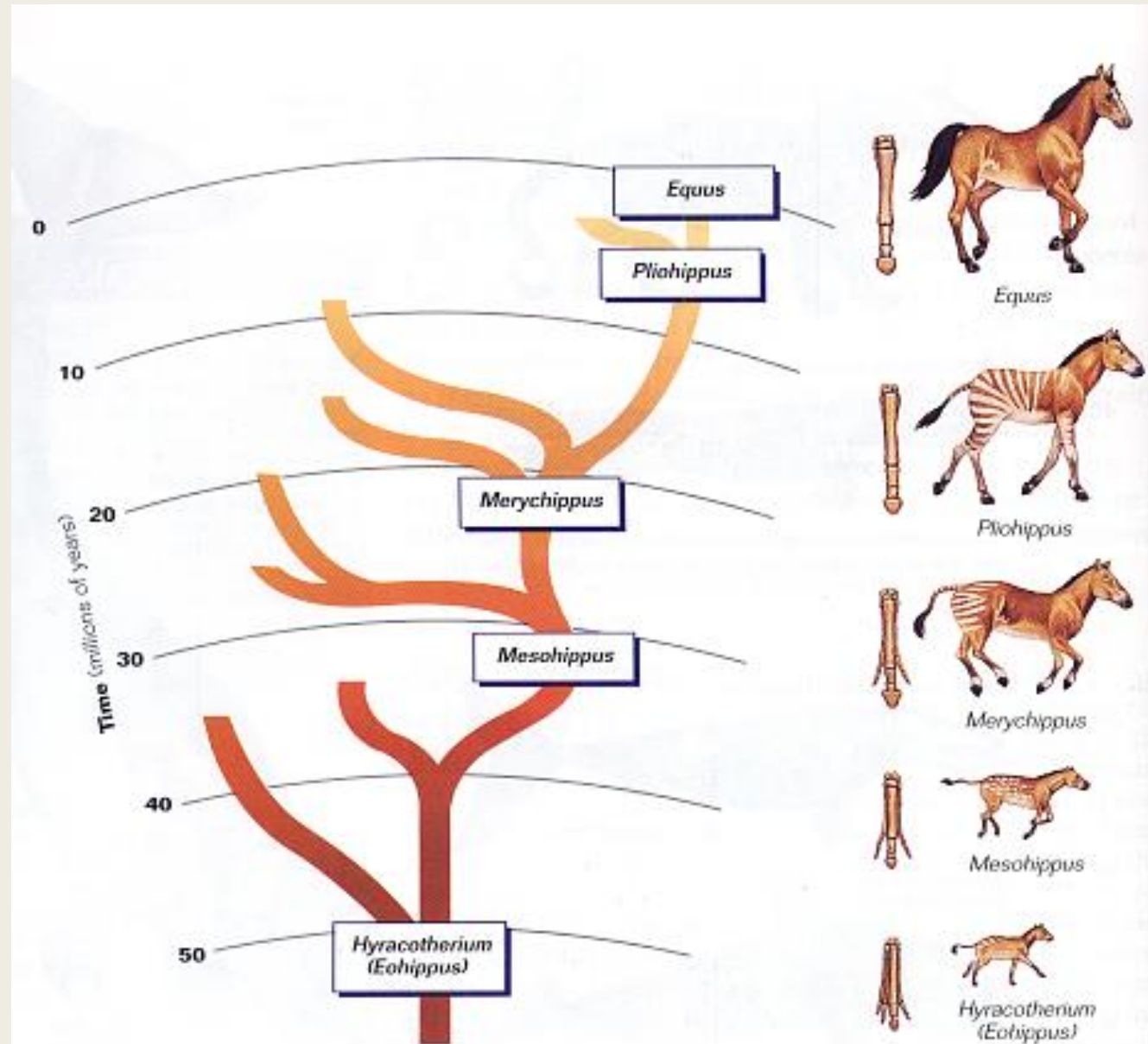
60 million
years ago

Today



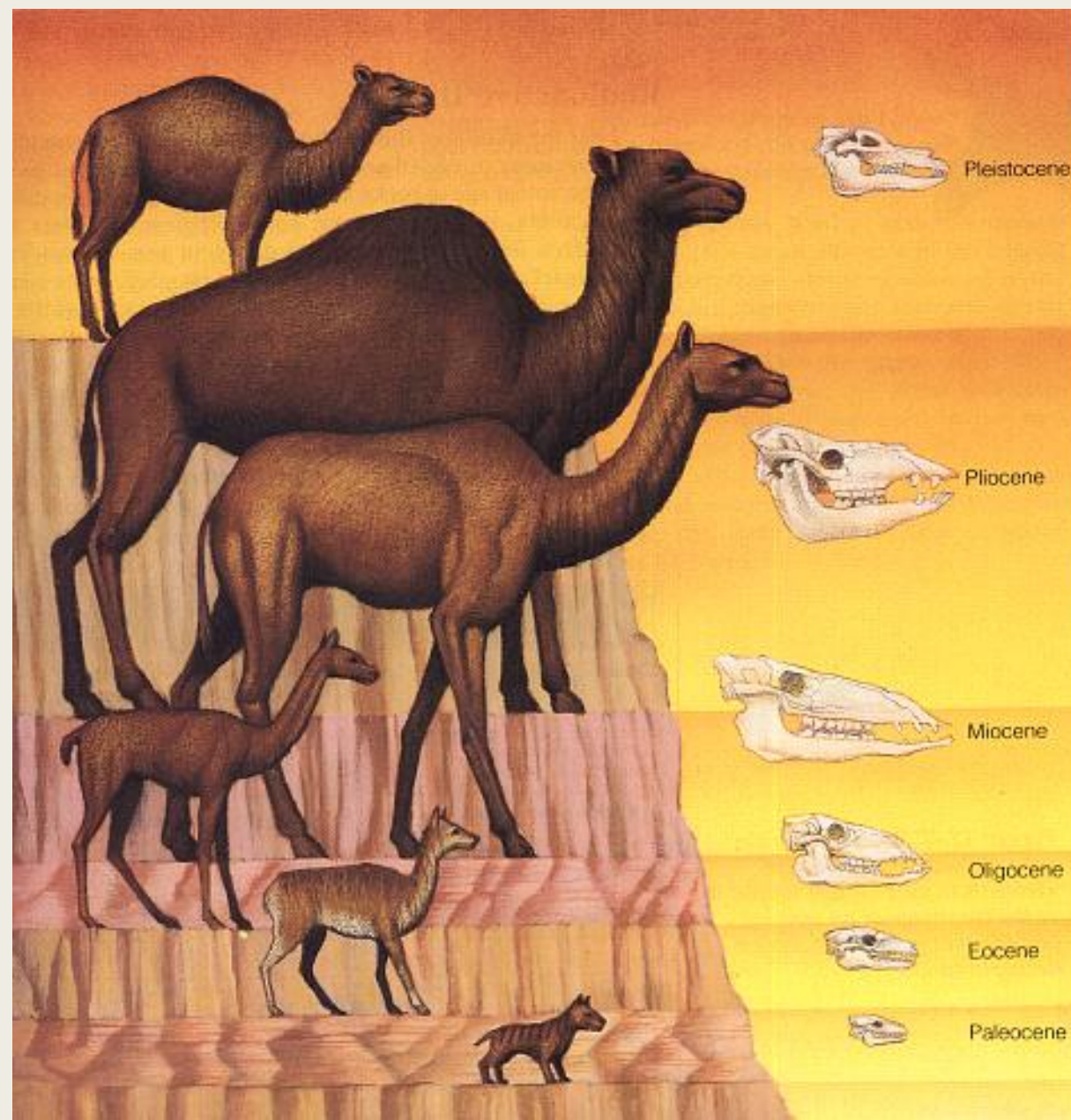
Fossil record of the modern horse

Today
↑
55 million
years ago



Fossil record of the camel

Today
↑
40 million
years ago





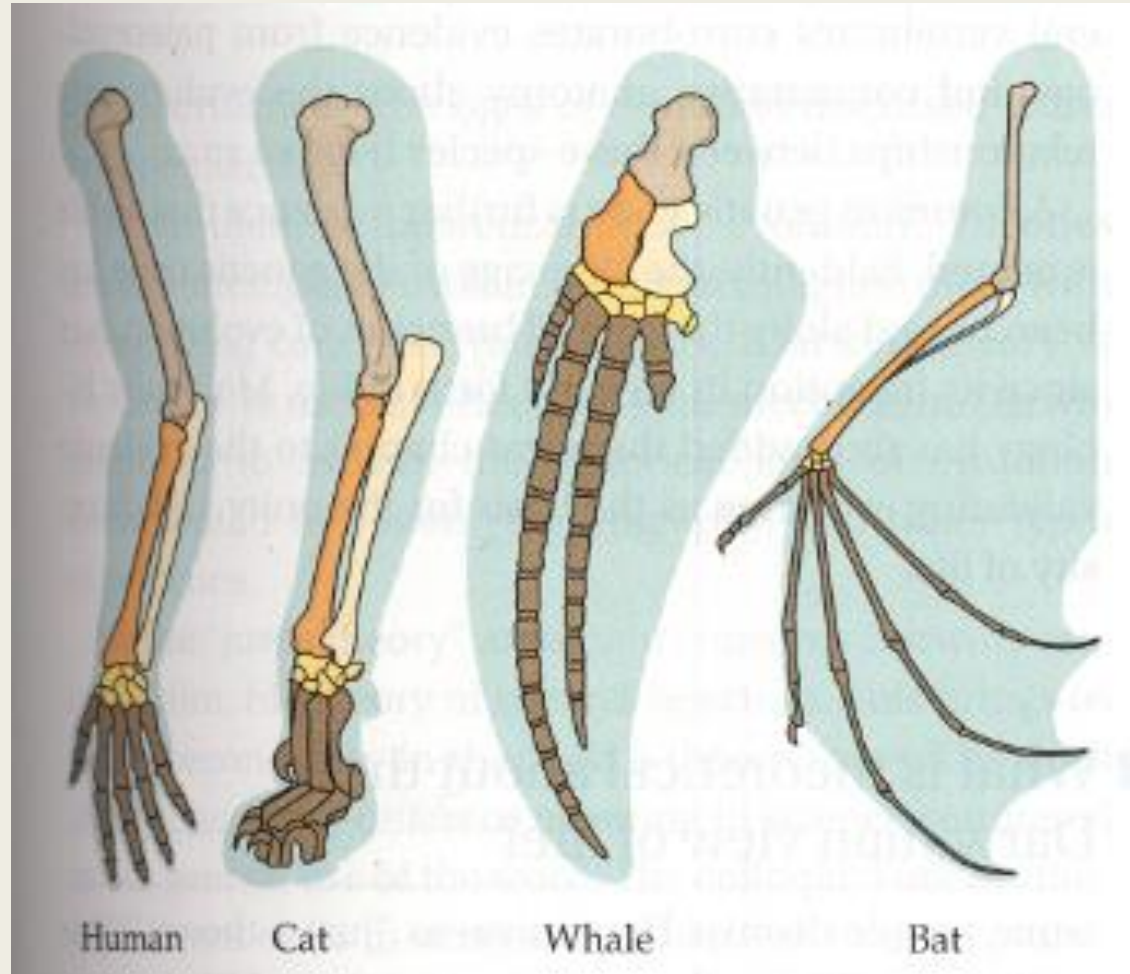
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**Homologous and Analogous
Structures**



Comparative Anatomy:

The limbs of all of these organisms are similar in structure even though their function may be different

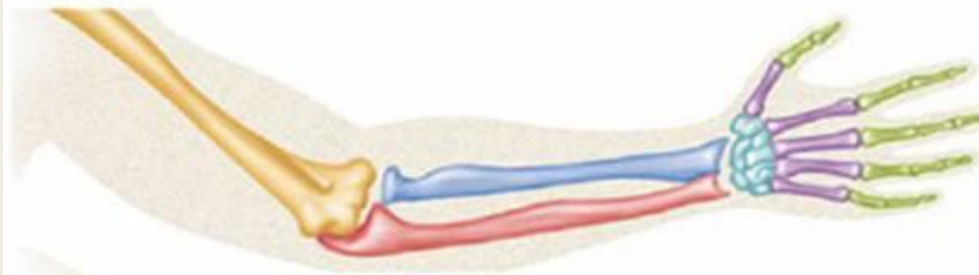


As vertebrates evolved, particular sets of bones were sometimes put to different uses...This may indicate a common ancestry

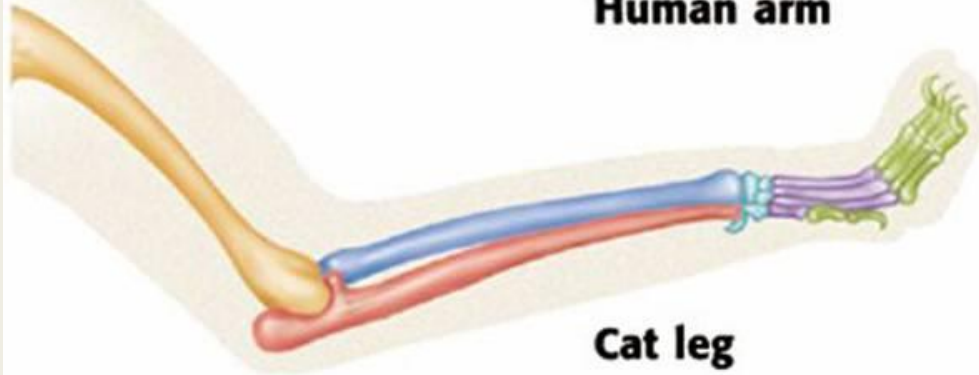
Homologous structure:

- structures that have different uses, but similar structures
- support that organisms evolved from common ancestor

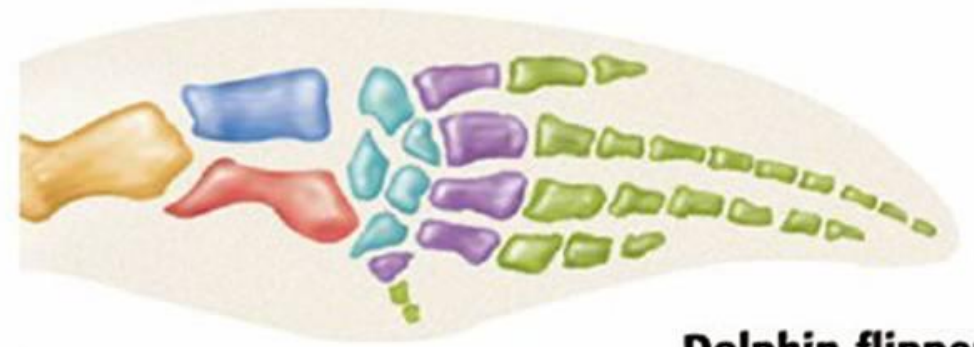
Comparing Skeletal Structures



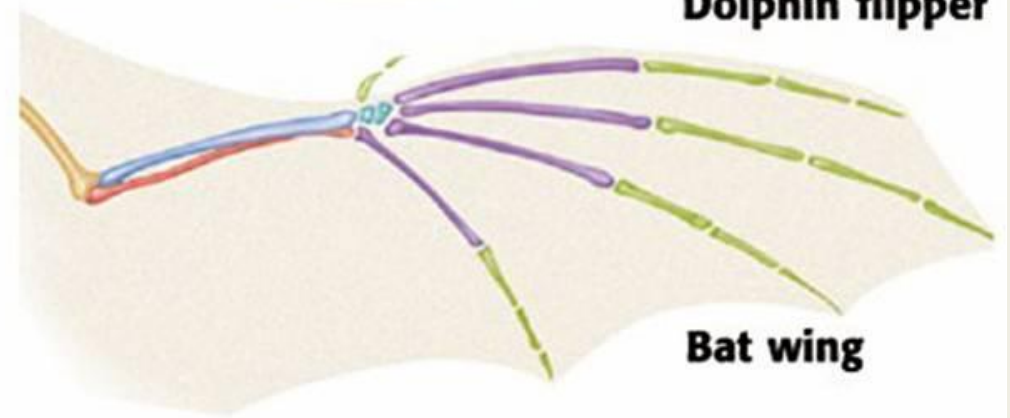
Human arm



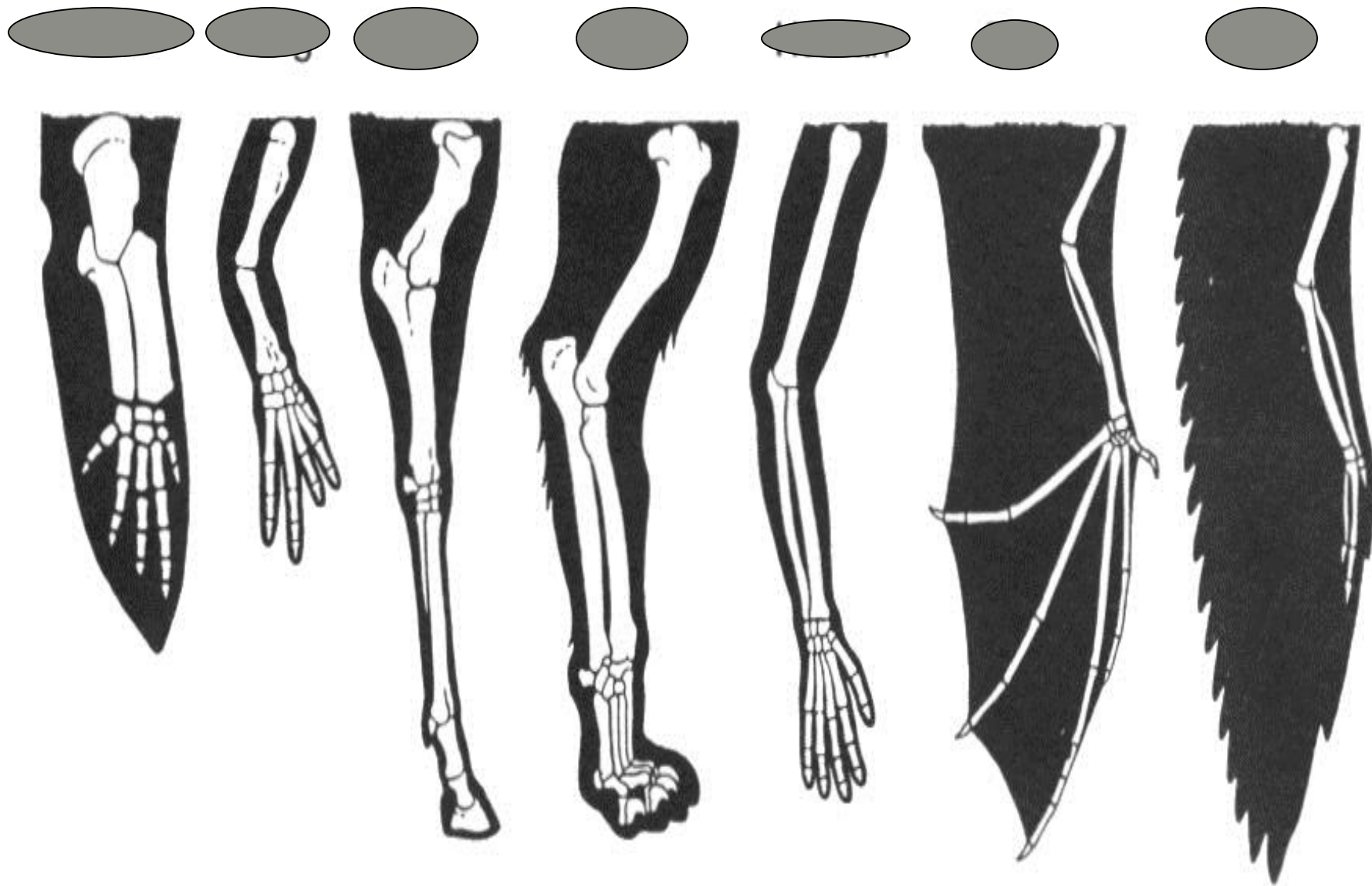
Cat leg



Dolphin flipper



Bat wing



Analogous structure:

- body parts that share similar function, but not similar structure
 - does not indicate common ancestor
- ex- wing a of fly and wing of a bird



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Vestigial Structures

vestigial structures: structures that no longer serve a function –

- Ex. Vestigial leg bones in a python

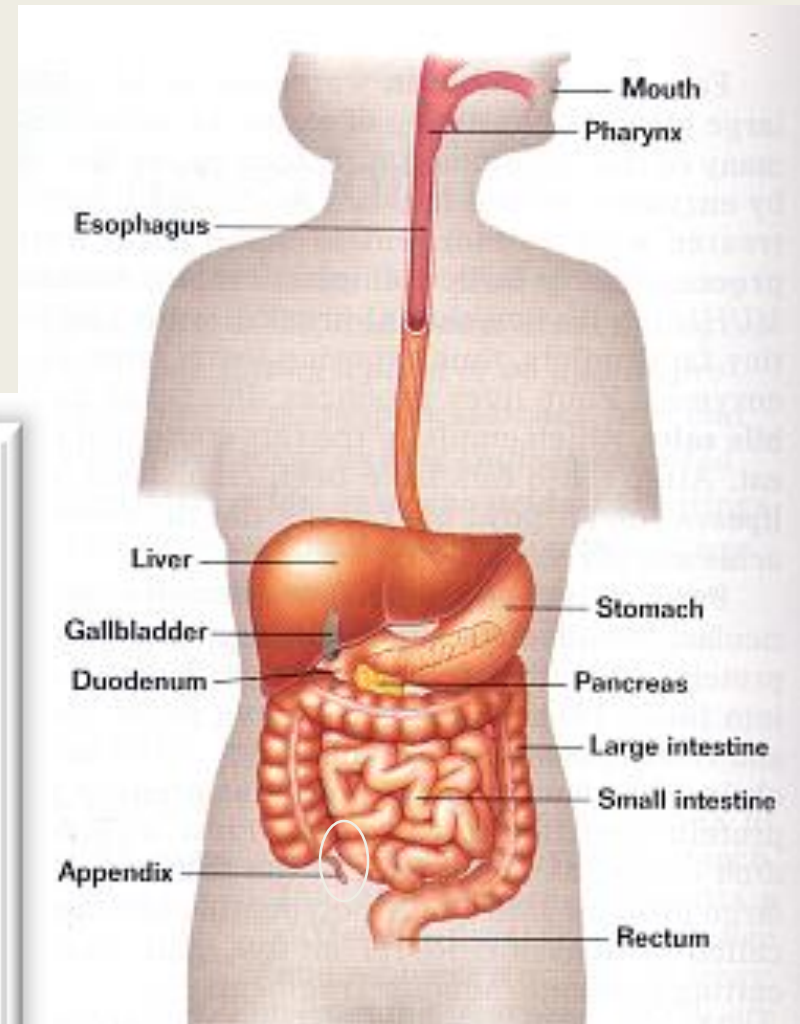
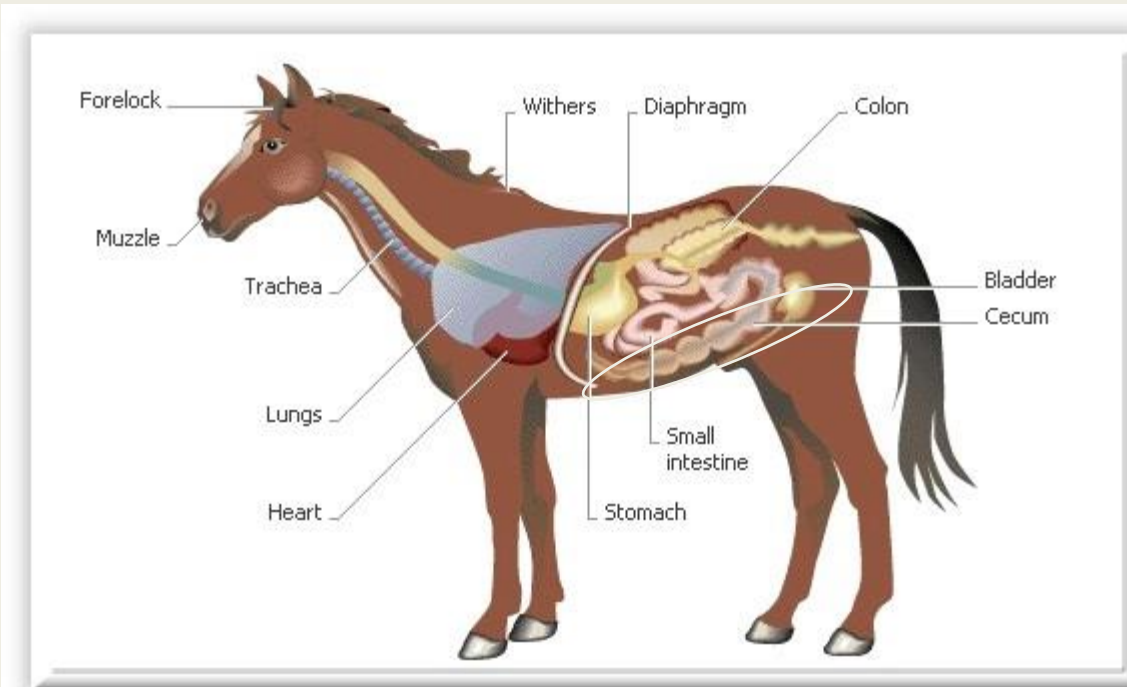


- Vestigial wings in a flightless bird
Ex a penguin and an ostrich

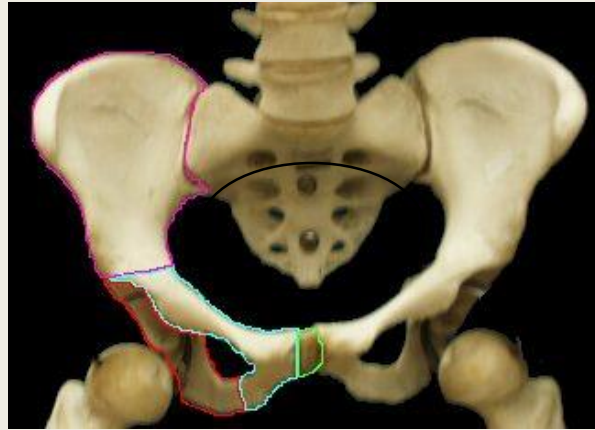


Human appendix is vestigial

- The human appendix has no function in humans but is very important in horses and other animals

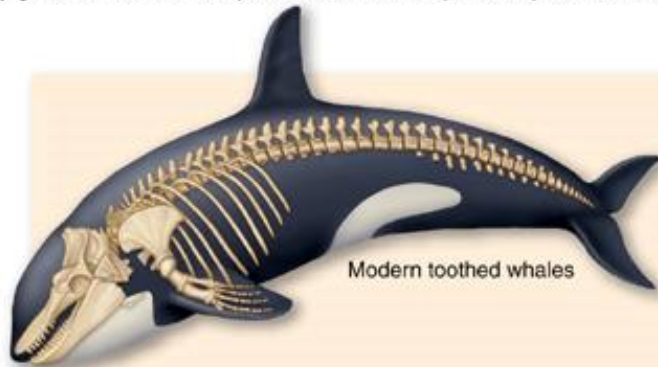


Human tailbone is a vestigial vertebrate tail



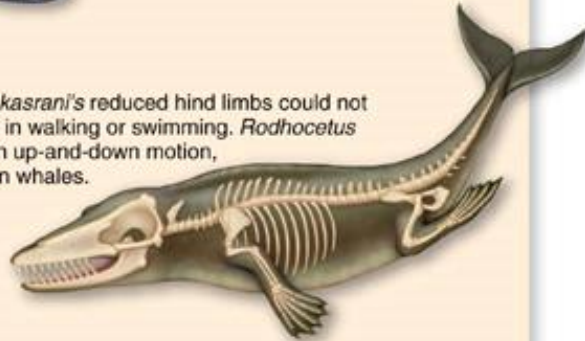
**Human tail bone
consists of fused
vertebrae that no
longer function
as a tail**





Modern toothed whales

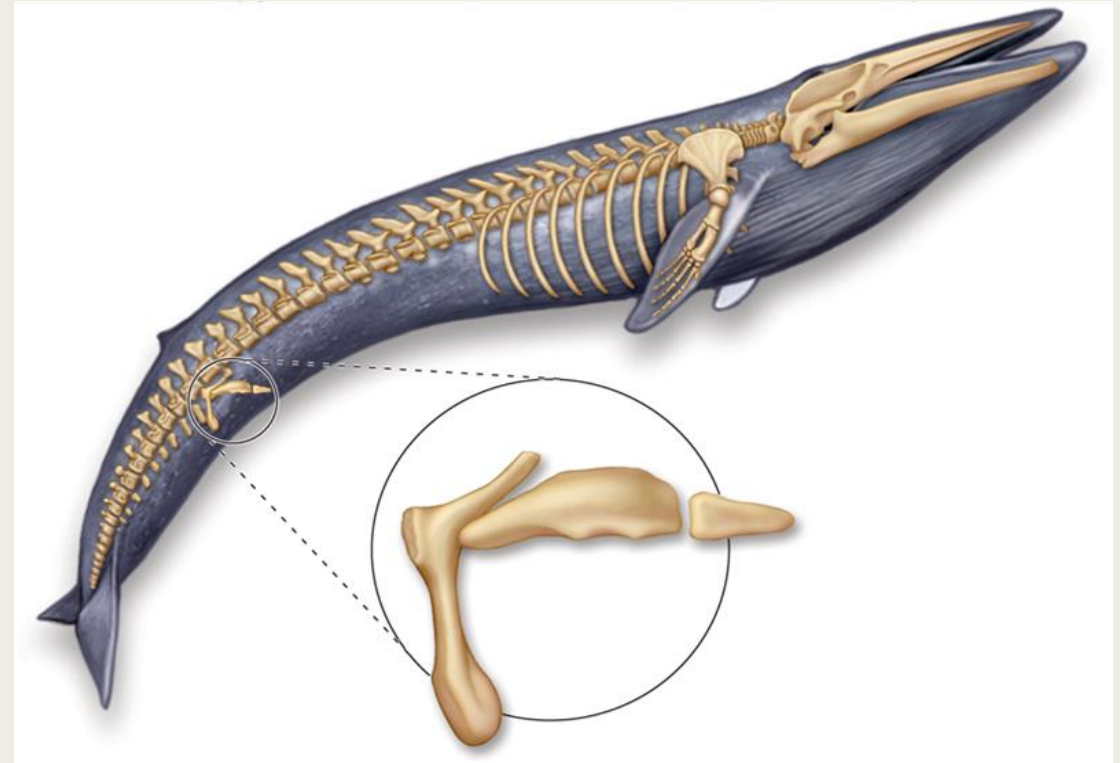
Rodhocetus kasrani's reduced hind limbs could not have aided it in walking or swimming. *Rodhocetus* swam with an up-and-down motion, as do modern whales.



Ambulocetus natans probably walked on land (as do modern sea lions) and swam by flexing its backbone and paddling with its hind limbs (as do modern otters).



Pakicetus attocki lived on land, but its skull differed from that of its ancestors and exhibited many characteristics seen in whales today.



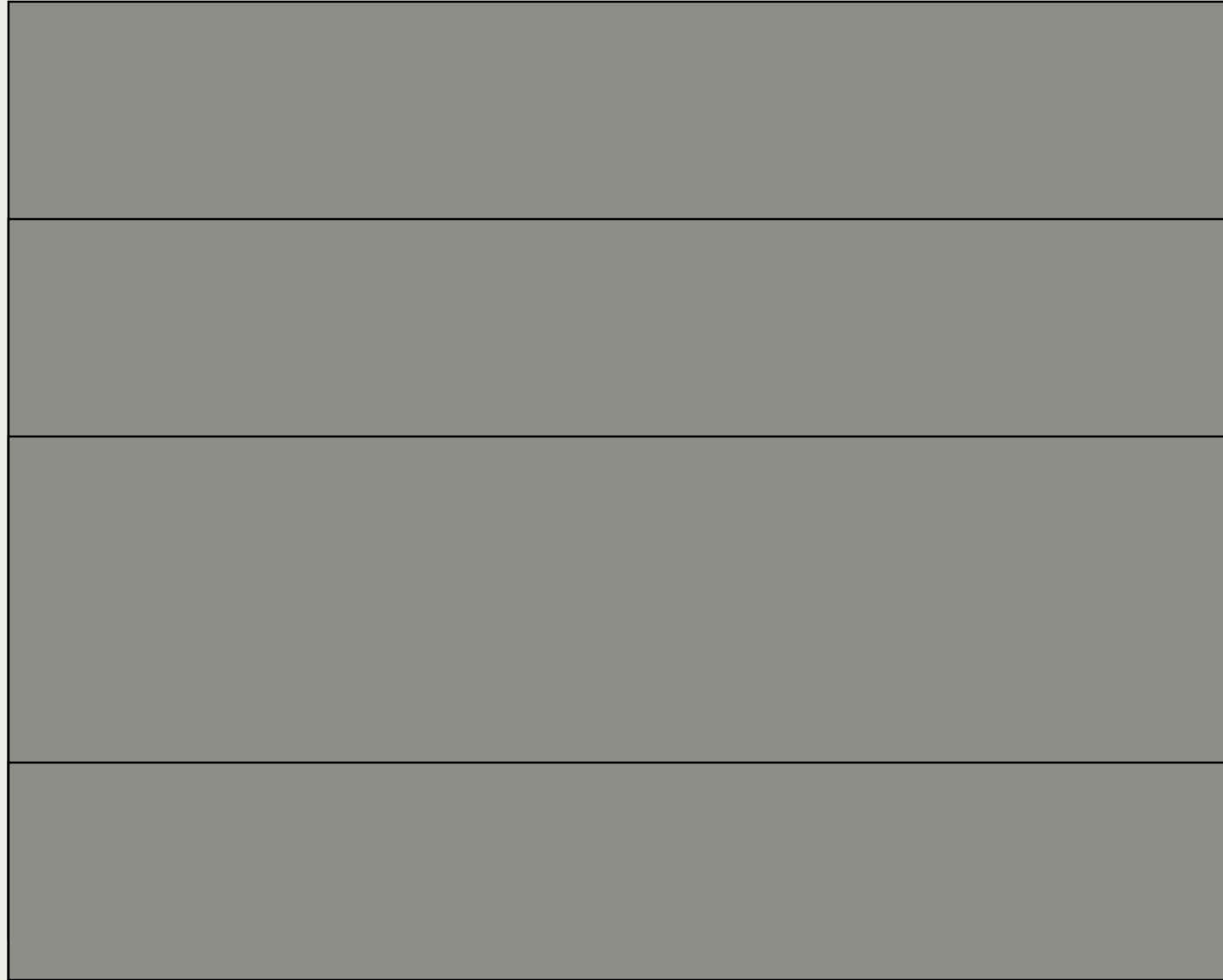
Vestigial structures of a whale

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Embryological Development

Embryology: similarities in early development



- Similar development must mean similar genes at work
- Similar genes indicated common ancestry.
- Differences in development are caused by genes that have mutated during the course of evolution.



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Biogeography



Biogeography: study of where organism live now and where their ancestors live in the past

- organisms evolve similarly in similar habitats

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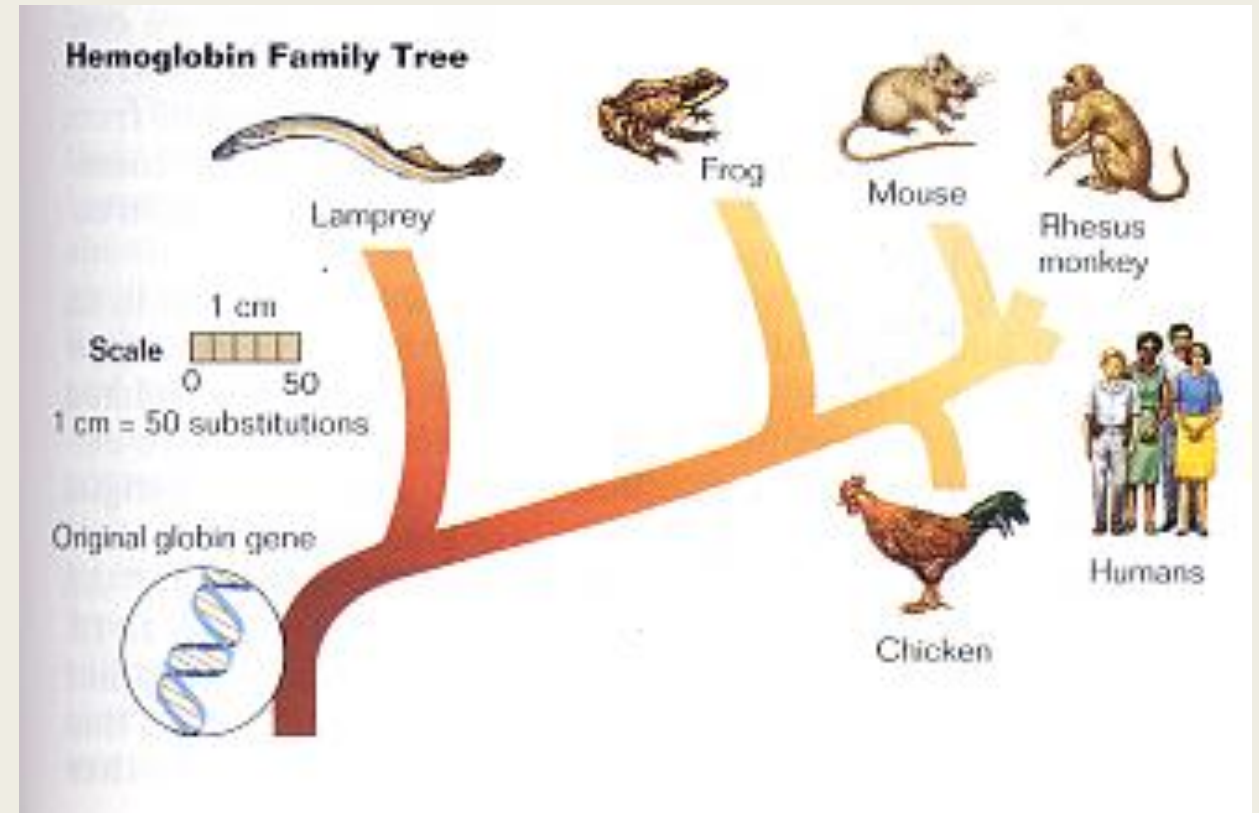
Biochemical (DNA)







Biochemical Evidence of Evolution

Hemoglobin in the blood

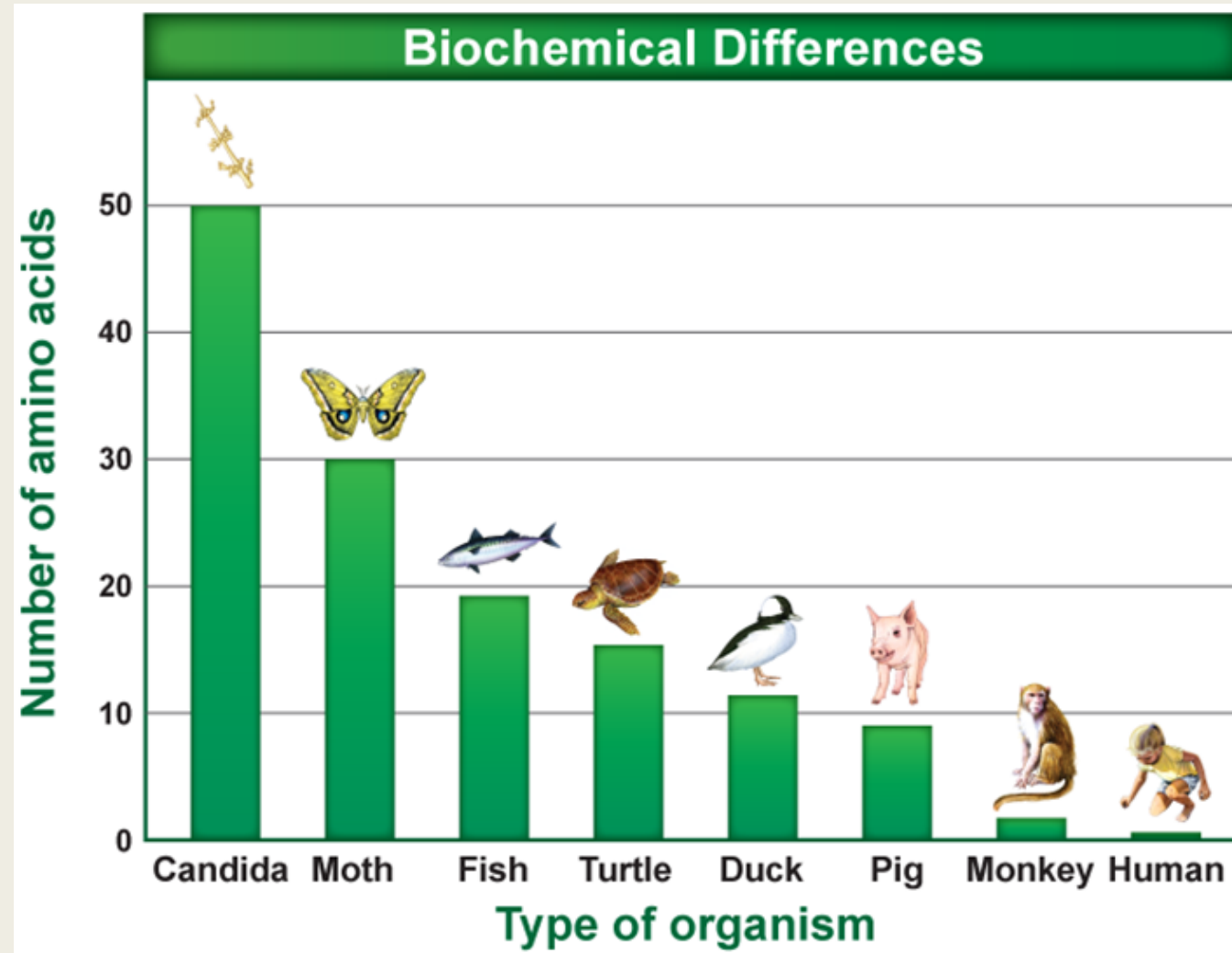
Table 12-1 Hemoglobin Comparison

Species	Amino Acid Differences
	Compared with human hemoglobin
Gorilla	1
Rhesus monkey	8
Mouse	27
Chicken	45
Frog	67
Lamprey	125



Species	Number of Amino Acids That Differ from a Human Hemoglobin Polypeptide (Total Chain Length = 146 Amino Acids)
Human 	0
Rhesus monkey 	8
Mouse 	27
Chicken 	45
Frog 	67
Lamprey 	125

- The more similar two organisms are, the more similar their DNA is.
- This would indicate that they animals evolved from a common ancestor.



Knowledge Check

True or False

Organisms with similar
anatomy share
similar DNA sequences.

Knowledge Check

Which features are similar in use and evolve in similar environments, but do not evolve from a common ancestor?

- A. analogous structures
- B. embryological structures
- C. homologous structures
- D. vestigial structures

Knowledge Check

Which of the following best explains how the fossil record provides evidence that evolution has occurred?

- A It indicates the exact cause of structural and behavioral adaptations of organisms.
- B It shows that the form and structure of groups of organisms have changed over time.
- C It shows how the embryos of many different vertebrate species are very similar.
- D It indicates that forms of life existed on Earth at least 3.5 billion years ago.

Knowledge Check

The occurrence of the same blood protein in a group of species provides evidence that these species

- a. evolved in the same habitat.
- b. evolved in different habitats.
- c. descended from a common ancestor.
- d. descended from different ancestors.

Knowledge Check

Which is an example of a vestigial trait in humans?

- A. a tail
- B. bones
- C. feathers
- D. teeth